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ABSTRACT

The relationship between visual stimulus intensity and directional finger movements was examined in infants of two age groups (16 infants, 10 to 15 weeks old, and 8 infants, 20 to 25 weeks old). Two hypotheses derived from Schneirla's Approach-Withdrawal Theory were examined: (1) that responses of the younger, but not of the older infants, would be directly related to stimulus intensity, with finger extension (approach) movements elicited by weak stimuli and flexion (withdrawal) movements elicited by more intense stimuli; and (2) that stimulus dimensions such as distance, size and brightness would make additive contributions to stimulus intensity, so that combinations of weak intensity would elicit finger extension and combinations of strong intensity would elicit flexion. Subjects were shown a red cone that varied in size, brightness and distance from the infant. An analysis of variance indicated significant age, intensity and age x intensity effects. As expected, as intensity increased, the younger infants' responses showed a decreasing proportion of extension movements, while older infants' responses indicated no clear relationship between intensity and response direction. The finding that younger infants were responsive to the quantitative rather than the qualitative aspects of stimulation has important implications for understanding how various stimulus dimensions affect infant responses. (Author/SB)

Age-Related Changes in the Relationship between Visual Stimulus Intensity and Directional Finger Movements in Infants

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Age-Related Changes in the Relationship between Visual Stimulus Intensity and Directional Finger Movements in Infants

During the past 2 decades a large number of investigations have been directed at identifying the aspects of visual stimulation to which infants respond. These investigations have followed the standard scientific procedure of manipulating a single variable, while holding all others constant. If the infant responds to these variations, the assumption has been that that particular variable is not only salient for the infant, but is also perceived as distinct from other aspects of stimulation present. In this way, infants' responsiveness to dimensions such as contour length (McCall & Kagan, 1967), contour density (Karmel, 1969), brightness (Hershenson, 1964), amount of change (Cohen, 1969), number of angles (Hershenson, Munsinger & Kessen, 1965), etc. have been identified.

It is possible, however, that infants do not respond to these dimensions as such, but respond to an aspect of stimulation that is common to each. Since varying stimuli along a dimension results in differences in the amount of stimulation, infants may be responsive to the quantity of stimulation provided, rather than the quality. Each dimension may be effective on the basis of the quantitative contribution it makes to the total amount of stimulation. In this view, an object is an effective elicitor of responses in terms of the level of stimulation it provides, and dimensions are viewed as additive in their contributions to this total level of stimulation.

This point of view is derived from Schneirla's Approach-Withdrawal Theory (1959, 1965) which states that at early stages of development there

is a direct relationship between the level of intensity of stimulation to which an organism is exposed and the direction of subsequent movements that are made. Specifically, young organisms tend to approach weak sources of stimulation and to withdraw from more intense sources of stimulation. It should be noted that the theory predicts response direction as a function of stimulus intensity only at early stages of development. Specific hypotheses regarding response direction at later stages are not clearly formulated, except that responses at later stages are not expected to be as directly related to stimulus intensity.

In the current study, the finger movements of infants of different ages were observed in order to examine the relationship between stimulus intensity and directional responses. Finger movements were chosen because of their relevance to such basic behaviors as reaching and grasping. Since extension in general serves to decrease the distance from an object, and flexion in general serves to increase the distance, extensions are considered approach responses and flexions are considered withdrawal responses. Thus, is it hypothesized that in young infants weak stimuli will elicit finger extension and more intense stimuli will elicit finger flexion, while older infants will respond differently.

If stimulus dimensions are considered to be effective in terms of their quantitative contributions to intensity, then they should be additive in their effects upon responsiveness. Therefore, when various attributes of an object are varied so that different levels of each are presented in different combinations, it is expected that there will be extension to weak combinations and flexion to more intense combinations.

In order to test these two hypotheses, infants of different ages were shown a stimulus object that varied in three attributes -- distance, size, and brightness, and the direction of their finger movements was recorded.

Subjects

This report is based on data from 16 infants from 10 to 15 weeks of age, and 8 infants from 20 to 25 weeks of age, with equal numbers of males and females in each age group.

Stimulus

The stimulus was a highly textured, slowly rotating red cone which could be presented in different combinations of distance, size and brightness. It could be near or far, large or small, bright or dim. Near was 18 inches from the infants' eyes. Far was twice that distance. Large was 7 inches base diameter of the cone, small was half that size. Bright was 1200 Lux, dim 300 Lux.

There were eight possible combinations from NLB to FSD presented to each infant in a different randomized sequence of 5-second trials which was repeated until $\frac{1}{2}$ hour had been videotaped or the infant became too fussy to be quieted. Infants were tested only in a quiet, alert state.

Apparatus

The apparatus is shown in the first slide which is a schematic drawing of what was a curtained chamber. The infant sat at (I), facing a display panel (G). The cone is visible at (F) through the open curtains. The mother and the experimenter were at (H) on the other side of the display

panel where they could watch the infant via television. The camera (E) was focused on the infant through a hole in the top of the chamber.

Two scorers independently scored each tape without knowledge of the stimulus conditions. Possible scores for each trial were extension, flexion, or no response. The measure used to analyze the results was a ratio score, number of extensions over total number of extensions and flexions. For example, if an infant's extension ratio score were .25 for the NLB cone, that meant that $\frac{1}{4}$ of his initial responses to that stimulus were extensions and 3/4 were flexions.

Results

To test the hypothesis that there would be age-related differences in responding as a function of stimulus intensity, it was necessary to look at finger responses to stimuli of clearly different intensities. However, since it was not known how much each attribute contributed to total intensity, it was impossible to rank all the combinations. However, far-small-dim was clearly the least intense combination (having the lower value for each dimension) and NLB was the most intense (having the higher value for each dimension). So we first compared the mean extension ratios of the two age groups to these two stimulus conditions.

As can be seen in the next slide, the younger infants had significantly higher extension ratios to the far-small-dim (the weakest) stimulus than they did to the near-large-bright (the strongest). In contrast, the older infants had significantly higher extension ratio scores to the strongest than to the weakest. Comparing the two age groups directly, there was a tendency for the younger infants to extend more to the FSD cone than did the older

infants.

That the infants were responding to the combinations of distance, size and brightness, rather than to only one or two of the dimensions was indicated by the failure of an analysis of variance to find significant main effects or two way interactions. There was, however, a significant 4-way interaction between age, distance, size and brightness ($p < .002$) and a tendency toward a main effect of age ($p < .07$).

To further explore this age difference in pattern of responding, we examined the extension ratios to stimuli of intermediate intensities. To do this, we ranked the intensity of the various combinations according to the number of high values in each, regardless of dimension. Four intensity levels were achieved as shown in the next slide. It should be noted that the validity of this ranking depends upon the assumption that all the lower values were approximately equal and that all the higher values were approximately equal.

The next slide shows the extension ratios of the two age groups to the stimuli of four levels of intensity. The younger infants' responses followed an intensity gradient, with progressively lower extension ratios as stimulus intensity increased. The responses of the older infants were not systematically related to intensity. These differences in responding were significant, as shown by an analysis of variance in which age, intensity and age x intensity were all statistically significant effects.

Summary and Discussion

The findings were supportive of the hypothesis that younger infants tend to approach weak and withdraw from more intense sources of stimulation. These

results are consistent with those of other studies in which stimulus intensity was related to directional responding in infants. To give one example among many, Hershenson, Munsinger and Kessen (1965) presented patterns with different numbers of angles and found that newborns looked longest at patterns with intermediate numbers of angles, rather than fewer or more. Similarly, Karmel (1969) found an optimal level of contour density for eliciting looking behavior in infants of roughly the same ages as we tested.

In each of these studies, stimuli were manipulated along a single dimension and intensity effects were observed. In our study, three attributes of a stimulus were varied and the results suggested that the effects of such variations were additive, and to some extent interchangeable. It is interesting to note that in other studies in which more than one dimension has been manipulated, the data have also suggested summation of the effects from the different dimensions. For example, Fantz and Fagan (1975) got interactions between size and numbef of elements, while Greenburg and Blue (1975) got interactions between contour density and number of elements in visual patterns. If each of these dimensions were considered to be effective in terms of their contributions to stimulus intensity, rather than as separate dimensions, the kinds of effects reported would have been expected.

In conclusion, the younger infants in this study tended to make approach responses to weak intensities of stimulation and withdrawal from stronger intensities, with 3 stimulus attributes making additive contributions to the total intensity which determined response direction. These findings have important implications for the way in which stimulus attributes are considered to affect responses in young infants.

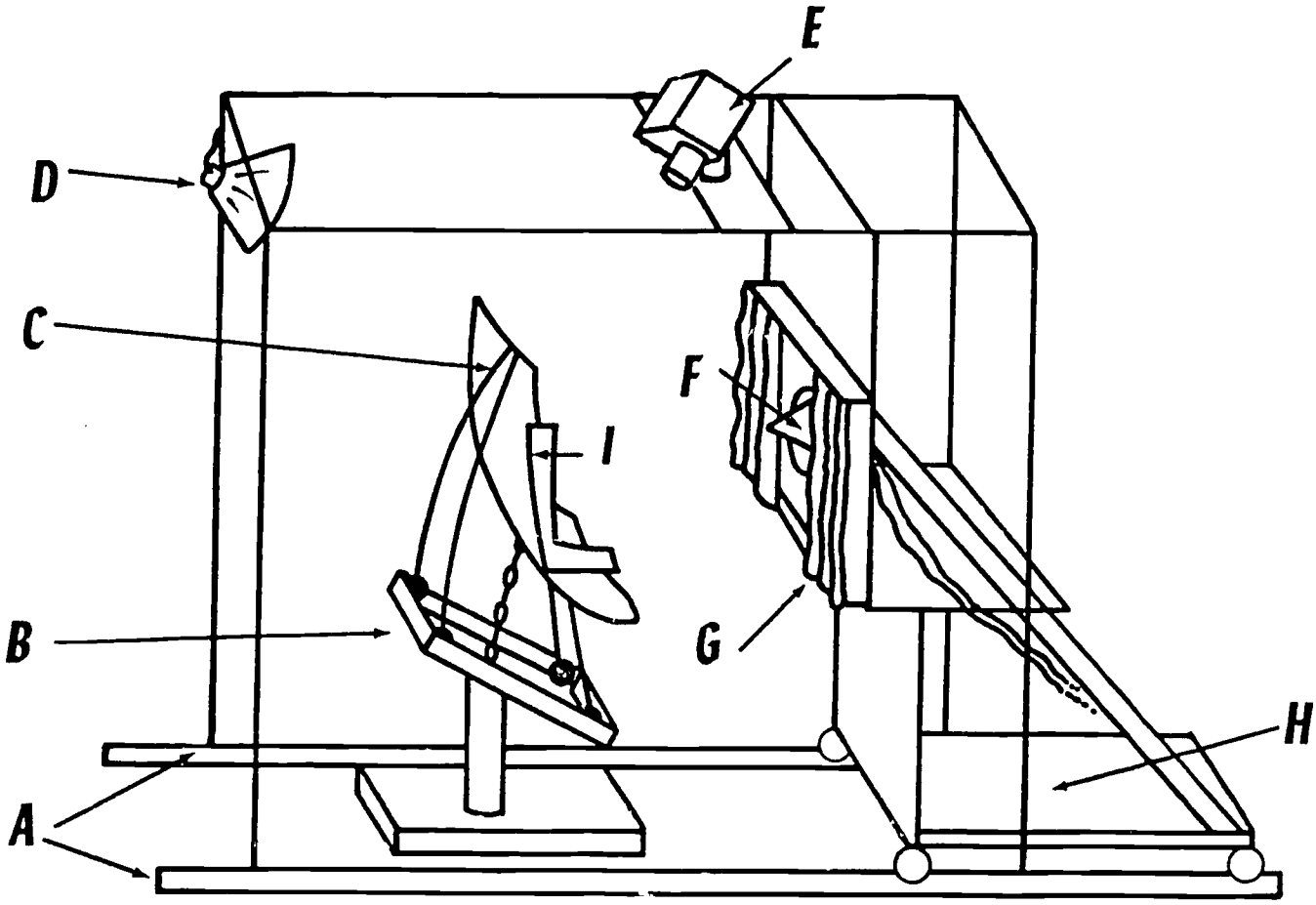

E
D
C
F
I
B
G
H
A

Table 1

Mean Finger Extension Ratios

to the Least and to the Most Intense Stimuli

by Infants of Two Age Groups

Age Group	n	Stimuli: Far-Small-Dim	Stimuli: Near-Large-Bright	t
10-15 Weeks	16	.765	.555	2.32***
20-25 Weeks	8	.656	.793	2.29**
t =		1.36*	2.46***	

*p < .10

**p < .05

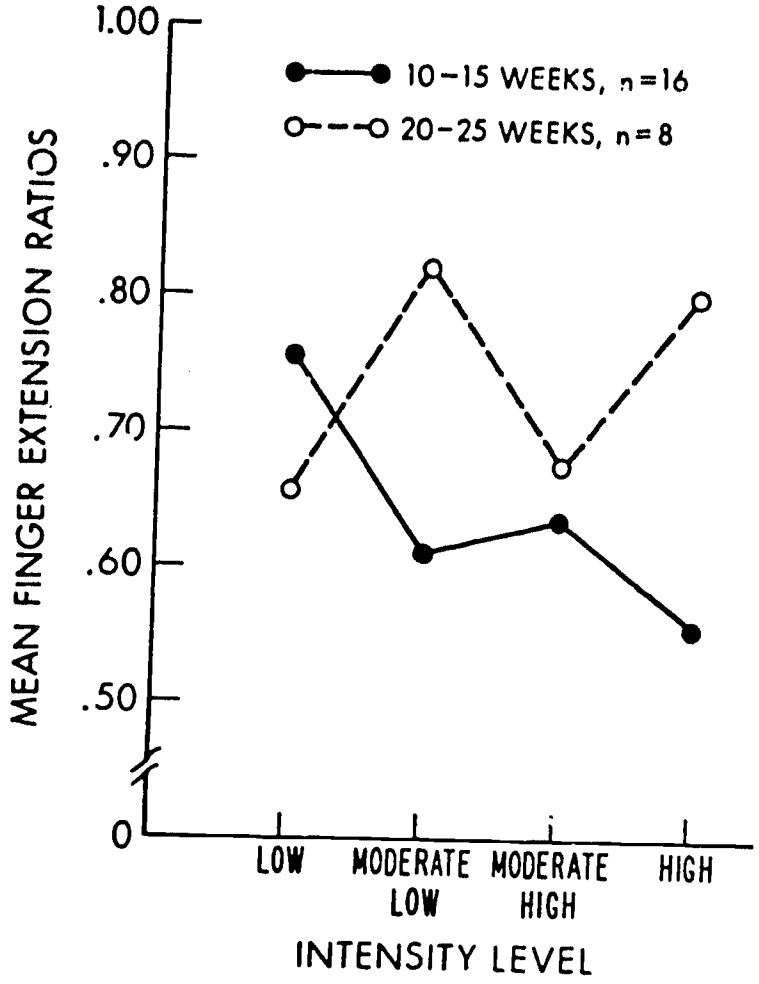
***p < .025

Table 2

Stimulus Combinations Ranked According to Intensity Level

Intensity Level	Number of Dimensions With High Values	Stimulus Combinations
Low	none	FSD[a]
Moderate-Low	one	NSD, FLD, FSB
Moderate-High	two	NLD, NSB, FLB
High	three	NLB

[a] F = Far, N = Near, S = Small, L = Large, D = Dim, B = Bright


1.00
.90
.80
.70
.60
.50
0
MEAN FINGER EXTENSION RATIOS
10–15 WEEKS, n=16
20–25 WEEKS, n=8
LOW
MODERATE LOW
MODERATE HIGH
HIGH
INTENSITY LEVEL